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U.S. land-cover database prototype for global map

Researchers at the Center for Advanced Land Management Information Technologies (CALMIT) of the Conservation and Survey Division (CSD), in cooperation with the U.S. Geological Survey's EROS Data Center (EDC), have published a unique land-cover database for the conterminous United States that will aid global environmental change research, assessment of biological diversity, drought monitoring and watershed management, among other uses. The U.S. database is a prototype for a global land-cover mapping project that will be carried out over the next five years by the University of Nebraska-Lincoln's CALMIT and the U.S. Geological Survey's (USGS) EDC team.

The new map developed from the database shows 159 "seasonally distinct" land-cover regions. In addition, the database is available on CD-ROM, is compatible with most geographic information systems and can be reconfigured for many purposes. CALMIT is also beginning to work with other units of the UNL Institute of Agriculture and Natural Resources to refine this data and develop a current, detailed Nebraska land-cover database.

One indication of the importance of the project is that USGS research scientist Tom Loveland, the project's co-director along with Jim Merchant, CSD geographer and associate director of CALMIT, was chosen by the USGS as the prestigious Mendenhall Lecturer for 1994. The Mendenhall Research Seminar highlights the work of one USGS scientist as being outstanding in the survey. During 1994, Loveland will be presenting the land-cover characterization project to other scientists at various USGS offices throughout the country and will be at UNL this fall.

(See **Land cover** *continued on page 2.)*

Management for conjunctive use means more data needed to represent complexity of resource, researcher says.

Nebraska's water flows through legal ground where more knowledge is crucial for future management, said Jim Goeke, research geologist with the University of Nebraska-Lincoln Conservation and Survey Division (CSD). Goeke opened the 1994 Nebraska Water Conference with a presentation highlighting variables that complicate integrated management of Nebraska's surface water and groundwater resources, or conjunctive use.

The annual Nebraska Water Conference was held March 14-16 in Lincoln. It was co-sponsored by the Nebraska Water Conference Council, the University of Nebraska-Lincoln, the UNL Institute of Agriculture and Natural Resources, the UNL Water Center/Environmental Programs and the Nebraska Research Initiative.

Conjunctive use was embraced when it was recognized that changes in surface-water patterns affect groundwater, and vice-versa. The difficulty is identifying what changes affect what area in what way.

"The cycle of groundwater recharge is a complex system simplified with a limited amount of knowledge," Goeke said.

Basic variables affecting integrated surface-water and groundwater management are climate, topography, soils, the unsaturated zone and the saturated zone, Goeke said.

Precipitation is the most unpredictable variable in conjunctive water use; amounts vary over the length of the state, (as well as over time). Rain

(See **Conjunctive use** *continued on page 3.)*

State's first digitized soil map demonstrated at GIS fair

Visitors at the Capitol Rotunda GIS Fair in this winter saw Nebraska's first digitized soil survey map on ARC/VIEW, a menu-driven program that displays geographical information in layers. Francis Belohlavy and Steve Hartung, soil scientists with the University of Nebraska-Lincoln Conservation and Survey Division (CSD), demonstrated how soil survey information can be accessed through ARC/VIEW.

Map features such as hydrology, roads, section lines, soil boundaries, center pivots and registered wells can be retrieved through the menu and viewed individually or as a composite image. Information about soil can be compiled to reveal characteristics such as dryland and fertility capabilities, corn yields, shrink-swell potential, the erosion factor, steel-corrosion capability, pH and depth to the water table in a given area.

The program was a result of a project started by the Lower Platte North Natural Resources District (NRD). The NRD contracted with an environmental engineering firm to make a computer model of the Cottonwood Creek Watershed area in Saunders County. The county was concerned about nonpoint-source pollution borne by runoff.

(See **Soils map** *continued on page 3.)*

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Land cover *continued from page 1*

"It may seem surprising, but even in this age of satellite remote sensing, there are few current, detailed maps of land use and land cover, and none for the globe," Merchant said regarding the need for this kind of work. He and others at CALMIT and the EDC, an international center for satellite remote sensing in Sioux Falls, S.D., have been working with images obtained from weather satellites because of the practical difficulties involved in using Landsat imagery.

"It would take hundreds of Landsat images, for example, to cover the United States, creating enormous, and very expensive, data-handling problems," Merchant said, explaining why the project has focused on the broad coverage provided by the Advanced Very High Resolution Radiometer (AVHRR). These images cover about 2,700 kilometers and have a resolution of about one kilometer--compared with the 30-meter resolution of Landsat. But in contrast to Landsat images, which are acquired about once a month, they are taken every day, so short-term changes in land cover can be easily tracked.

By computing a "greenness" index for each 1-kilometer segment in an image, scientists can relate photosynthetic activity in plants to seasonal variations and changes in moisture regimes and land cover. The rate and timing of greenness change over a growing season is an indication of the type of land cover in a particular 1-kilometer area, Merchant said. These distinguishing characteristics were first used to identify 70 land-cover groupings, which were further divided into the current 159 land-cover types.

CALMIT staff have recently prepared maps for both the Platte and Missouri river basins. Data from the U.S. project were revised, and during 1994 they will be mapping North America with 1992 AVHRR data as the first continent in the global land-cover characterization.

The EDC-CALMIT dataset is the only database ever produced for the U.S. from one year of data and has much greater detail than any other existing national land-cover map, Merchant said. Future efforts will be to determine the effects of interannual climatic changes on land-cover mapping, to assess map accuracy, to improve mapping techniques and to develop strategies to extend the project around the globe.

Funding for the Nebraska database is coming from the National Biological Survey, the USGS, NASA and the U.S. Environmental Protection Agency. The Nebraska project will combine satellite remote sensing, air-photo interpretation and field work to develop a high-resolution (30-120 meter) land-cover inventory for the state. The dataset is scheduled for completion in late 1995.

Map sales place CSD among top 100 map dealers in the nation

The University of Nebraska-Lincoln Conservation and Survey Division (CSD) Maps and Publications Department is one of the top 100 map dealers in the United States. Judy Otteman, manager of the map sales department, said she was unaware of that designation until she received a visit from Peter Zuniga of the U.S. Geological Survey (USGS) distribution branch in Denver.

Zuniga said that he wanted to see the division's office because of their high volume of sales. The map selection is probably one reason that sales are so good.

"There are over 1,400 topographic maps, alone," Otteman said. "We carry about 2,000 (maps) total."

Before he left, he invited Otteman to visit the USGS map distribution center office in Denver.

Otteman accepted the invitation and went to Denver last July. She returned to the division with even more maps to add to the extensive selection, including the U.S. Department of Defense World Map, The National Geographic Society Map of the United States, the USGS Map of the Emerging Nation and their Indian Tribes Map. Other new maps include The United States by Satellite View, a digital shaded relief map of the conterminous United States and a U.S. Congressional Territories map.

"We try to keep 30 of each on hand," Otteman said. Some are more popular than others. The most popular are the seven and a half minute USGS (topographic) maps."

Otteman estimates that 90 to 95 percent of the maps are sold to the general public. They are popular with lawyers and business people for property issues, and Boy Scout troops use the maps to plan hikes. One woman even came in and bought maps for her husband's Christmas gift, she said.

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Conjunctive use *continued from page 1*

provides overland runoff, filling streams. It also replenishes groundwater. Adequate precipitation also serves to diminish irrigations needs within a given period, so less groundwater is pumped and surface water diverted for that purpose. More than 77,000 irrigation wells are registered in Nebraska, causing a significant impact on groundwater levels in some areas.

Subsurface geology, soil types and topograpy also influence surface-water and groundwater flow patterns. Subsurface geology contributes to the transmissivity of groundwater--its capacity to move through the rocks. Most groundwater moves very slowly but some can move at much higher rates. Wells drilled in good-quality channel gravel can yield more than 1,000 gallons per minute, while other areas may not yield enough groundwater for domestic use.

Course-grained soils expedite infiltration, while fine-grained soils are likely to remain saturated for a longer period of time. Slopes and elevations in topography also affect streamflow and overland runoff.

"If it's flat, (the water) is going to sit there. If it's steep, it's going to run off," he said.

All these variables complicate conjunctive-use management, because each water-resource area has different combinations of these variables, Goeke said. Water-use legislation can't be uniformly applied when each area has a unique set of characteristics.

The differences among the Platte, the Republican and the Niobrara rivers demonstrate just how unique each system can be. The Republican and the Niobrara have cut streambeds down to bedrock, as opposed to the Platte, which comes through the state essentially on a ridge.

Streamflow sources differ as well. Groundwater inflow contributes nearly half the discharge of the Platte, and the Niobrara would probably disappear during drought years without the inflow of groundwater. The Republican, however, is primarily fed by overland runoff, Goeke said.

Diversion also plays a role in the characteristics of river systems. Much of the Platte is diverted for irrigation, particularly in Dawson and Phelps counties, he said. Besides significantly reducing the flow of the Platte, diversion has caused a rise in the groundwater levels in some areas due to seepage.

Management standards can't be applied to one system without affecting another. Lincoln citizens depend on the Platte to recharge the Ashland wellfield adjacent to the Platte for their water supply. The Platte, however, would be greatly reduced at Ashland without the discharge of the Loup and Elkhorn rivers, Goeke said.

Nebraskans have been blessed with abundant water resources. Nearly 66 percent of the Ogalalla (High Plains) Aquifer lies beneath Nebraska. With that blessing comes the responsibility to manage it wisely, Goeke said.

"The groundwater resevoir in Nebraska has been accumulating for at least 25 million years, and the surface water system has developed primarily in the last 10,000 years," Goeke said.

"We've only been measuring surface water for about 100 years, and groundwater for 50 years. It's presumptuous to think we adequately understand these complex systems, and as we discuss conjunctive use and integrated management of surface water and groundwater, I hope we recognize the complex interrelationships of these water systems."

Soils map *continued from page 1*

"They wanted to know if they were controlling erosion the way they thought they were," Belohlavy said. The engineers needed digitized information to produce the model. The county had a 20-year-old soil survey on a 2-acre grid system. At the time, researchers were already doing field work to update the survey, and CSD had a computer program that would digitize the results.

Soil survey maps are produced from two, distinct types of information: attribute data such as political boundaries, roads, soil pH and plant communities, and spatial data, which consists of the boundary lines separating different soil types. The spatial data usually resembles a jig-saw puzzle, defying a 2-acre grid system.

"Soil survey is an artificial grouping of a continuum," Belohlavy said. "Soil types generally follow topography."

Belohlavy was able to retrieve the attribute data for the Cottonwood Creek Watershed area from the National Soil Survey Data Base in Ames, Iowa.

Margaret Warner, a CSD database manager, has nearly finished converting the soil boundary lines into computer data. Using a computer tool similar to a mouse, she copies the lines directly from the mylar sheets used in the field.

The NRD was pleased with the results. When the model of Cottonwood Creek Watershed Area was completed, more pollution and erosion potentials were recognized in the area, and control measures were proposed. The NRD requested digitized information for the rest of the county.

Saunders County is a critical area because Lincoln gets its water from the county at Ashland, Belohlavy said. There has been concern about atrazine found in the Ashland well fields. The computerized soil survey can demonstrate runoff and tell where erosion loss is highest, he said.

"If you're losing soils, you're probably losing chemicals, too," Warner said.

Erosion analysis isn't the only use for the soil survey. The government uses the survey to help evaluate tax assessment. Homeowners apply the information to lawn care, sewer and septic tank needs and potential building sites. Farmers learn about drainage, irrigation needs, what types of crops to plant and the best cultural practices to use, Belohlavy said. Cultural practices have become especially important because of the Food Security Act, which ties price supports to management practices.

The soils haven't changed as much as the way we look at them, Belohlavy said, although agriculture has had some effect.

"If you've farmed a soil for 20 years, it's definitely not the same as it was 20 years ago, Warner said.

"The land still needs to be protected," Belohlavy said.

GIS Literacy Institute for Librarians at Iowa University

Soon, geographic information systems will be as close as the local library, and GIS experts are preparing to train librarians to handle the new technology.

Jim Merchant, associate director of the Center of Advanced Land Management Information Technologies at the University of Nebraska-Lincoln, is helping to develop the GIS Literacy Institute for Librarians, a project started at the University of Iowa by geography professor Marc Armstrong.

The institute, sponsored by the U.S. Department of Education, will offer three four-day training sessions June 5-8, 9-12 and 19-22. Merchant will be one of the instructors at the sessions, which will be held at the University of Iowa.

"We'll have around 150 to 200 librarians from all over the country," Merchant said. "We will have access to the computer lab and to Internet in Iowa."

GIS training is becoming imperative for librarians, because more and more census and map data is being produced in digital form.

"When people come in to ask for data, the librarians will know how to refer them," Merchant said.

The training sessions come on the heels of a pilot project in Nebraska designed to evaluate the feasibility of an online "card catalog" system of GIS spatial data. The Nebraska GIS Steering Committee, the Department of Roads and the Nebraska Library Commission worked together to create a successful prototype.

For more information about the GIS literacy training session, contact the University of Iowa Center for Conferences and Institutes at (319) 335-3231.

Coming up: local, state and national meetings and workshops

--Nebraska Well Drillers Association Special Field Workshop: Water Well Drilling Using Bentonite Drilling Fluids, New World Inn, Columbus, April 21-22.

--Nebraska Academy of Sciences annual meeting, Olin Hall, Nebraska Wesleyan University, April 22

--North-Central Section of the Geological Society of America annual meeting, Western Michigan University, Kalamazoo, Mich., April 28-29.

--Mid-America GIS Symposium: Promoting Cooperation in the 1990s, Hyatt Regency Hotel at the Crown Center, Kansas City, Mo., May 3-4.

--ERDAS Workshop: Essentials of ERDAS IMAGINE 8.1, Kansas City Airport Marriot, Kansas City, Mo., May 5-6.

--Tenth Thematic Conference on Geologic Remote Sensing, San Antonio, Texas, May 9-12.

--Groundbreaking for the Agricultural Research and Development Center, Mead, May 13.

--Nebraska State Rock, Gem and Mineral Swap, Grand Island Earth Science Society, Isaac Walton Park, Grand Island, May 14-15.

--Northeast Nebraska Rock and Mineral Society Show, Norfolk, May 21-22.

--American Association of Petroleum Geologists annual meeting: Analogs for the World, Denver, Colo., June 12-15.

--The Wyoming Geological Association and Friends of the Tate Museum: A Field Conference, The Dinosaurs of Wyoming, June 16-19.

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